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Arbitrary self-configuring optics – a new opportunity for silicon photonics

Zepler Institute International Distinguished Lecture.

Professor David A. B. Miller, Ginzton Laboratory, Stanford University

Abstract

Silicon photonics technology allows the construction of highly complex circuits. There are many potential applications for sophisticated linear optical operations, including mode separation and conversion for communicating with multiple spatial modes, quantum optical circuits, and linear processing generally. Designing such circuits and fabricating, calibrating, and setting up the necessary interferometric circuits for any complex function has, however, been challenging. We have recently shown [1,2] first that it is possible to implement arbitrary linear operations with a mesh of interferometers, proving in principle we could make any linear optical component. Second, if we use detectors, local feedback loops and simple progressive algorithms, it is possible to design and set up such a component entirely without any calculations or component calibrations and based only on training with an appropriate set of optical beams [2]. In a recent extension [3], we showed that it is not even necessary that the interferometers are fabricated very precisely, opening the possibility of mass fabrication, with relaxed manufacturing tolerances, of optical field-programmable linear arrays (FPLAs) for this wide range of uses. This approach may open a broad new range of systems in optics and substantially expand the applications of silicon photonics technology.

[1] D. A. B. Miller, "Sorting out light," Science 347, 1423-1424 (2015) doi: 10.1126/science.aaa6801

[2] D. A. B. Miller, "Self-configuring universal linear optical component," Photon. Res. 1, 1-15 (2013) doi: 10.1364/PRJ.1.000001

[3] D. A. B. Miller, "Perfect optics with imperfect components," Optica 2, 747-750 (2015) doi: 10.1364/OPTICA.2.000747

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All staff and students are invited to attend. The lecture will be held 10:00-11:00am and will be followed by refreshments and an opportunity for networking.

Prof David A.B. Miller

David Miller is the W. M. Keck Professor of Electrical Engineering and Professor by Courtesy of Applied Physics at Stanford University. He was with Bell Laboratories from 1981 to 1996, as a department head from 1987. His interests include nanophotonics, quantum-well optoelectronics, and optics in information sensing, interconnects, and processing.

He has published over 260 scientific papers, holds over 70 patents, is the author of the textbook Quantum Mechanics for Scientists and Engineers (Cambridge, 2008), and has taught open online quantum mechanics classes to over 10,000 students. He was President of the IEEE LEOS (now Photonics Society) in 1995, and has served on Boards for various societies, companies, and university and government bodies.

He was awarded the OSA Adolph Lomb Medal and the R. W. Wood Prize, the ICO International Prize in Optics, the IEEE Third Millennium Medal, and the 2013 Carnegie Millennium Professorship. He is also a Fellow of APS, OSA, IEEE, the Electromagnetics Academy, the Royal Society of London and the Royal Society of Edinburgh, holds two Honorary Doctorates, and is a Member of the US National Academies of Sciences and of Engineering.

Tuesday 5 July 2016, 13:00 - 14:00. B58 1067 Murray Building, Highfield